

RE-LOCATE LLC



August 10, 2017

Marcia B. Mia
Office of Compliance/Air Branch
2227A WJCS
U.S. Environmental Protection Agency

To Marcia Mia:

Please accept this letter as a follow up to our teleconference on July 26, 2017. The contents below are provided in response to your request for more information about the Kivalina Biochar project in order to guide the EPA's determination about whether a federal air quality permit is required.

Kivalina Biogenic Refinery

The Kivalina Biogenic Refinery (the Kivalina Biochar Reactor, or the "System") is a pilot health and sanitation project pursuant to Joint Resolution 15-01 of the City of Kivalina and the Native Village of Kivalina (signed February, 2015, and updated September, 2015). The Kivalina Biogenic Refinery is designed to process solid human waste from Urine Diverting Dry Toilets (UDDTs) and refine the waste into biochar—a carbon-rich, high-energy dense solid.

Overview of the System

The Kivalina Biogenic Refinery is a compact, community-scale, relocatable human solid waste refinery designed and built by Re-Locate LLC in partnership with Biomass Controls, LLC. The System processes solid human waste via pyrolysis (combustion in a low-oxygen

environment) from UDDTs installed in Kivalina homes and outputs inert, pathogen-free biochar along with thermal energy in the form of heat. The pyrolysis system is sized to eventually accommodate human solid waste from Kivalina's population of approximately 500 residents, although only 8–10 families are using UDDTs at the present time. The System is rated to process 400 pounds per day of daily biogenic waste. The thermal rating of the System is 175,000 BTUs, a thermal output that is less than many residential heating systems.

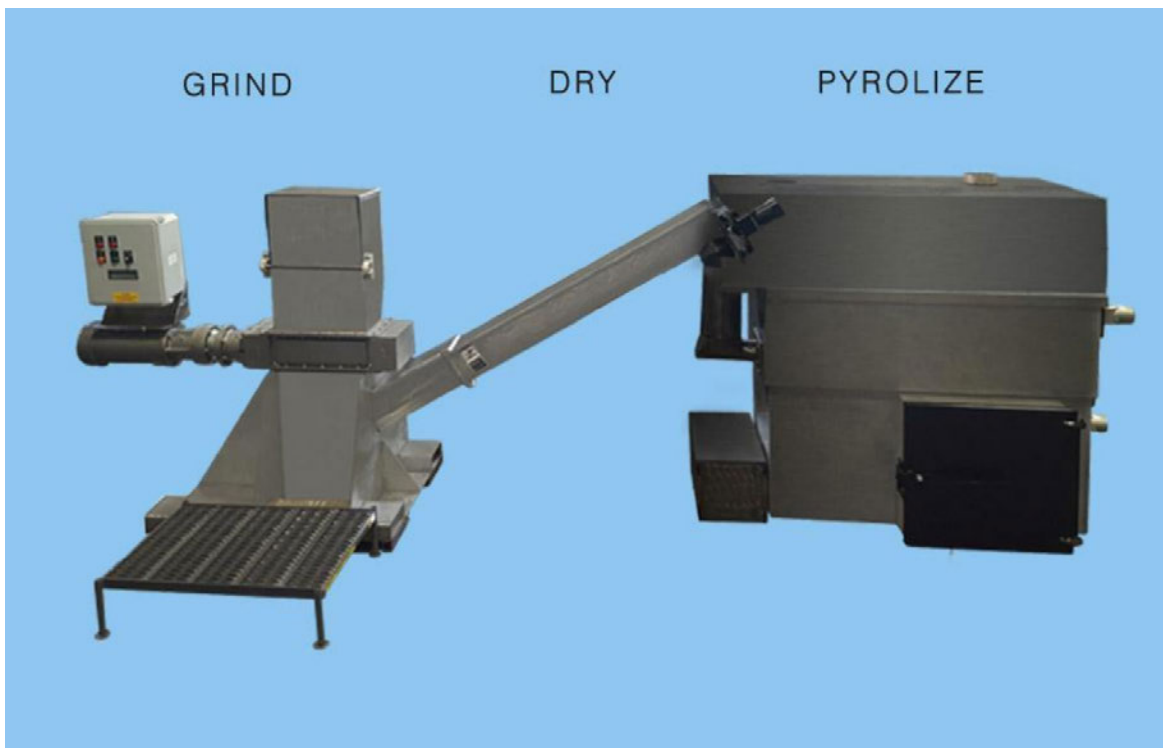
The System arrived in Kivalina on July 8, 2017, via delivery by an Alaska Marine Lines landing craft. As soon as required permits have been obtained, Re-Locate LLC will organize an operator training program to initiate local operations. [REDACTED]

System Specifications

The Kivalina Biogenic Refinery consists of three main components: the grinder, the transport auger, and the pyrolysis system. System components are built together and housed inside a single, 8x20' insulated shipping container. The container will rest on wooden dunnage sized to fit the container. The gross unit weight of the container is 14,300 pounds.

The System uses cardboard as fuel during start up. Once running, feedstock material is fed into the grinder by dedicated, trained operators. The grinder, designed for the waste industry, allows pre-processing of wipes or tissue paper which may be present in the feedstock. Ground material is fed by a transport auger for pyrolysis. During this phase, the System sustains pyrolysis by using thermal energy generated from the feedstock; no co-firing of fossil fuels or outside heating is required after system startup. After pyrolysis, the System employs a thermochemical process at the catalyst to refine emissions. Excess thermal energy generated by the System pre-dries feedstock as it moves through the transport auger. Air from the pre-processing grinder is pulled into the System through a carbon filter to control odor.

The System utilizes automated intelligent controls and a catalyst for managing pyrolysis and emissions.



System illustration.

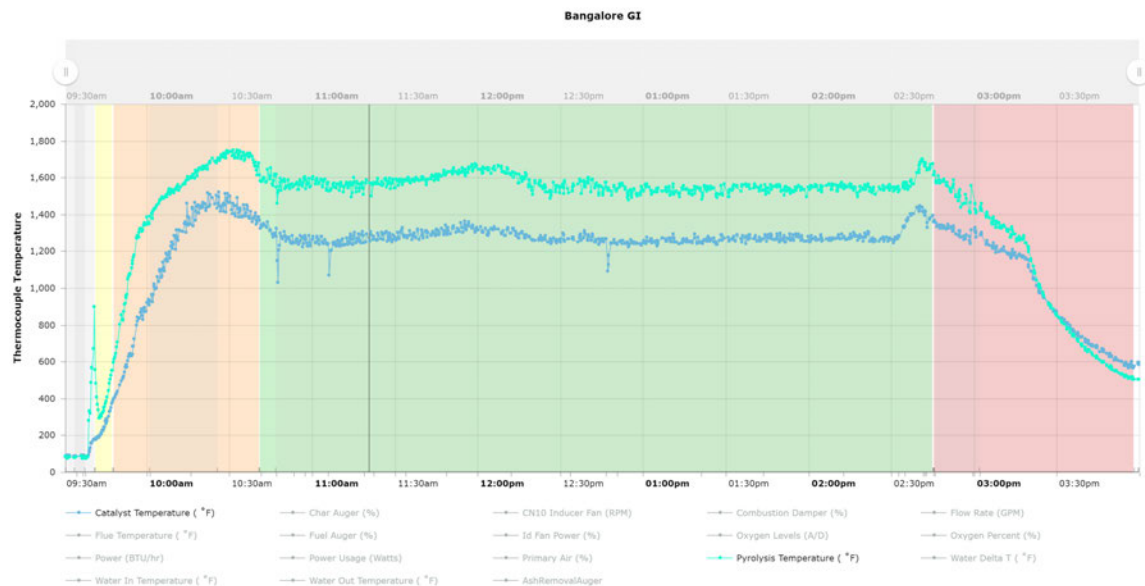
Pyrolysis Process

The feedstock undergoes pyrolysis in the pyrolysis pot, at temperatures between 600–900C. Pyrolysis temperature, heating rate, and residence time variables are optimized to reduce clinkers and minimize NO_x and SO_x emissions while ensuring a pathogen-free output. Feedstock is exposed to heat for approximately 20 minutes while moving through the Biogenic Refinery.

The Biomass Controls Intelligent Biofuel Controller uses oxygen sensors, thermocouples, thermistors, and pollution control technology to monitor System conditions. Variable Frequency Drives (VFDs) control oxygen levels by varying the amount of air that is added during the pyrolysis process. The control boards can adjust system conditions such as oxygen levels, feedstock fuel rates, biochar export rates, and pollution control to maintain pyrolysis. The control boards are microprocessor-based, have been in use since 2013, and have passed UL Certification under IEC 61010-1.

Time and Temperature Profile

The profile below charts time and temperature data from a Biogenic Refinery built for use by communities in Bangalore, India. The India refinery, also built by Biomass Controls, is an earlier model than the Kivalina model, but it uses the same pyrolysis process (similar time and temperature operations) as the Kivalina unit to process solid human waste.



Catalyst

After pyrolysis, System emissions undergo a thermochemical process by passing through a stainless-steel monolith catalyst coated with platinum and other noble metals. The catalyst is located approximately 3 feet from the pyrolysis chamber, and refines System emissions to CO₂ and gaseous H₂O before exhausting through the stack.

Power Requirements

The power requirement of the System during run state (steady state), or the maximum energy draw, was measured to be less than 600 watts/hour. The grinder, which will be operated intermittently, is rated to 3.7kW/hr. The System is designed to run fully off renewable wind and solar energy. We have not secured the funds needed to purchase the renewable energy hardware, so to initiate operations in Kivalina, we plan to draw power from an on-site 5 kWe generator.

Feedstock

System feedstock will be limited to solid human waste separated by UDDTs, in addition to toilet paper, wipes, wood pellets, and cardboard. No glass or metals can be processed.

UDDT Waste

UDDTs are waterless toilets whose ergonomic design separates urine and feces at the toilet. Dried solid waste collects and dries in a rotating bucket at the base of the UDDT that is lined with a biodegradable bag. Separated urine is batch discharged into the ground via a urine pipe. System users will collect the solid waste bag from the UDDT, seal the bag, and deliver it to a trained Kivalina Biogenic Refinery operator during open hours for processing. Because urine never comes into contact with the feces, UDDT solid waste has about a 35–40 percent moisture content. Kivalina families using UDDTs are emptying solid waste bags about 1–2 times per week.

Other Feedstocks

Cardboard: Cardboard, which has a high heat value (53,200 BTUs), purchased from the Kivalina Native Store and stored in a shipping container located adjacent to the System, will fuel System startup and shutdown.

Wood pellets: One ton of purchased residential grade wood pellets arrived with the System upon delivery. A small amount of wood pellets will be used to preheat the System prior to adding the UDDT bags. Wood pellets will be stored with the cardboard in a shipping container adjacent to the System.

Toilet paper and wipes: The System is designed with an industrial grinder (Muffin Monster Industrial Grinder #111908) to process the toilet paper and wipes that accompany the bags of UDDT solid human waste.

Throughput

Trained operators will run the System 2 days/week for 8 hour daily shifts. The System will be cycled each time it is operated.

Output & Waste Volume Reduction

If the System processed 200 pounds of waste a per week, we would expect to produce 20 pounds of char per week (10 percent output). The Kivalina Biogenic Refinery can reduce UDDT waste volume by 90 percent and meets EPA Part 503 Biosolids criteria.

By-product biochar will be used for odor control within the System. Studies have shown that biochar can also be used for water filtration and as a soil amendment, however these uses are not being pursued for Kivalina. The biochar that has been used by the System to filter odor will be re-processed prior to disposal in the Kivalina landfill order to ensure a pathogen-free output.

[REDACTED]

[REDACTED]

- [REDACTED]
- [REDACTED]

The Alaska Department of Environmental Conservation Air Permit Program, based on information Re-Locate LLC provided, determined that “combined annual emissions from both the System and the generator used to start the System would not trigger Alaska’s minor permit thresholds in 18 AAC 50.502(c)(1). In addition, the capacity of the reactor is below the cumulative rated capacity threshold of 18 AAC 50.502(b)(4). Therefore, we believe the Kivalina Biochar Reactor does not require a Title I minor air quality permit with the State of Alaska under Article 5 of 18 AAC 50.”

- [REDACTED]
- [REDACTED]
- [REDACTED]



Photo: Biochar produced by the System at Red Dog Port Site (14 miles from Kivalina), 12/16.

The Alaska Department of Environmental Conservation Solid Waste Program issued Re-Locate LLC a letter of non-objection for disposing of System biochar in the Kivalina municipal landfill based on biochar having pathogen concentrations less than the untreated material that is currently dumped at the landfill. Once the Kivalina Biogenic Refinery is operational, pathogen concentrations in the Kivalina biochar will be confirmed by analytical testing.

Performance Monitoring and Data Analytics

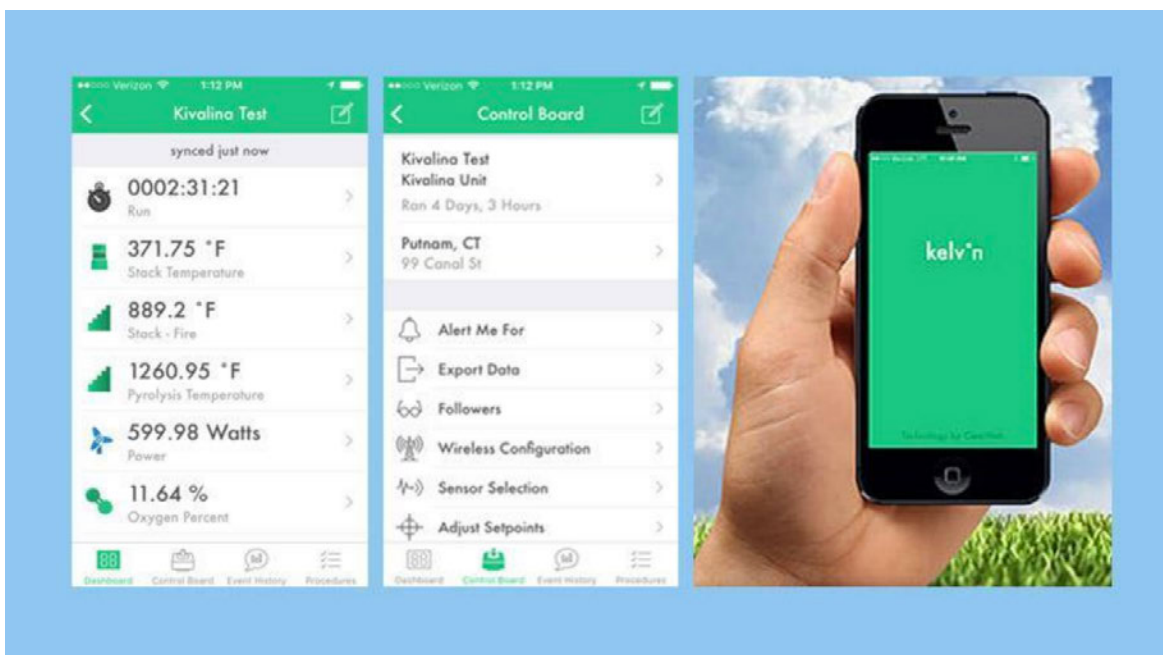
The advanced controls and catalyst performance will be monitored through Biomass Controls's online mobile application called Kelvin. Kelvin is available for download through the Apple store and Google Play. This software platform includes remote monitoring and data capture capabilities, which integrate with smartphones to allow for decentralized management. Kelvin also provides a flexible user interface, which can be integrated into a variety of interactive technologies, to facilitate system performance management.

In remote locations, local operators can use Kelvin to communicate wirelessly, allowing for remote monitoring and management support from a distance. The software includes system analytics that can be exported for analysis. The mobile application platform also allows

operators to pull and follow updated operating procedures. This ensures consistent operation of the Biogenic Refinery across users.

Kelvin also provides diagnostic functionality, alarms, and alerts to notify local operators and outside managers of System performance. System run data is fully accountable to allow for data-driven and results-based management of compliance, training, and System operation.

An example of a Kelvin reading taken during testing:



Permitting

As noted above, the AK DEC Solid Waste Division has issued Re-Locate LLC a letter of non-objection for disposing of biochar output at the Kivalina landfill and for reuse within the System as an odor filter. The State of Alaska Air Permits Program determined that the Kivalina Biogenic Refinery does not require a Title I minor air quality permit with the State of Alaska under Article 5 of 18 AAC 50. We are awaiting a determination from the EPA as to whether a federal air quality permit is needed.

Request for Determination

Based on the information we have provided above, we propose that the EPA regulate the System as a pyrolysis unit, which would make it exempt from Section 129 of the Clean Air Act. Please let either Jeff Hallowell or me know if you have further questions.

Sincerely,

A handwritten signature in black ink, appearing to read "Jennifer Marlow".

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A handwritten signature in black ink, appearing to read "Jeff Hallowell".

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